Exhibit A

Hawley's Condensed Chemical Dictionary

ELEVENTH EDITION

Revised by

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and
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New York

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"Blandol."[45] TM for white mineral oil (NF).
Use: Pharmaceutical and cosmetic formulations, plasticizers, paper penetrants, foam depressants.

blank. (1) A piece of material of any desired shape cut by a stamping die prepared for further processing. (2) See control (1).

blast furnace. A vertical coke-fired furnace used for smelting metallic ores, e.g., iron ore.

blast-furnace gas. Byproduct gas from smelting iron ore obtained by the passage of hot air over the coke in the blast furnaces. A typical gas will analyze 12.9% carbon dioxide, 26.3% carbon monoxide, 3.7% hydrogen, 57.1% nitrogen.
Hazard: Toxic by inhalation. See carbon monoxide.
Use: Heating blast-furnace stoves, boiler, or gas-engine fuel.

blasting agent. See black powder; ammonium nitrate; explosive, high, permissible, and low.

blasting gelatin. (SNG). A type of gelatinized dynamite containing approximately 7% of nitrocellulose.
Hazard: High explosive.

blasting powder. See black powder.

"B-L-E."[248] TM for high-temperature reaction product of diphenylamine and acetone.
Properties: Dark-brown, viscous liquid; d 1.087; soluble in acetone, benzene, and ethylene dichloride; insoluble in gasoline and water. Combustible.
Use: General-purpose rubber antioxidant.

bleach. To whiten a textile or paper by chemical action. Also the agent itself. Bleaching agents include hydrogen peroxide (the most common), sodium hypochlorite, sodium peroxide, sodium chlorite, calcium hypochlorite, hypochlorous acid, and many organic chlorine derivatives. Chlorinated lime is a bleaching powder used on an industrial scale. Household bleaching powders are sodium perborate and dichlorodimethylhydantoin.
Hazard: See calcium hypochlorite; lime, chlorinated. Some bleaching agents are toxic and strong oxidizing agents.

bleaching assistant. A material added to bleaching baths to secure more rapid and complete penetration of the bleach or improved regulation of the bleaching action, e.g., compounds of sulfonated oils and solvents, soluble pine oils, fatty alcohol salts, sodium silicate, sodium phosphate, magnesium sulfate, and borax.

bleach liquor. A solution of calcium hypochlorite and water.

bleed. (1) When a dye runs. (2) To release pressure gradually as via a valve.

blend. A uniform combination of two or more materials either of which could be used alone for the same purpose as the blend. For example, a fabric may be a blend of wool and nylon either of which is itself usable as fabric. Instances of materials that are often blended are:

plastics (polyblends)	grains
whiskeys	coffees
fabrics	paints
colors	tobaccos
metal powders	solvents
fertilizers	

See also mixture, mixing, kneading.

"Blendex."[525] TM for synthetic resinous products prepared from a variety of copolymer combinations. They are used to modify other polymers to attain a wide range of properties.

bleomycin. A glycopeptide antibiotic produced by *Streptomyces verticillus*, it functions as an antineoplastic and diagnostic agent. The molecule is exceedingly complex, but synthesis was achieved in 1982. It is a colorless to yellowish powder, soluble in water and methanol but insoluble in acetone and ether. It induces rupture of DNA strands.

blinding. (blister copper).
Properties: Copper (96–99% purity) produced by the reduction and smelting of copper ores. It has a blistered appearance probably caused by gas pockets. It is usually further refined electrolytically.

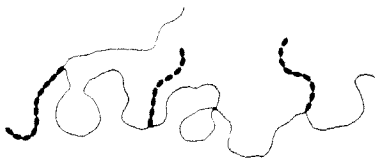
blister gas. See dibromodiethylsulfide.

blister packaging. A type of packaging used widely in the food and pharmaceutical industries consisting of a hollow cavity of various shapes and capacities in which the material is enclosed. Polyester and polyethylene resins are often used.

block. (1) Undesirable cohesion of films or layers of plastic.
See antiblock agent.
(2) A type of polymer.
See block polymer.

block polymer. A high polymer whose molecule is made up of alternating sections of one chemical composition separated by sections of a different

chemical nature or by a coupling group of low molecular weight. An example might be blocks of polyvinyl chloride interspersed with blocks of polyvinyl acetate. Such polymer combinations are made synthetically. They depend on the presence of an active site on the polymer chain which initiates the necessary reactions.
See also graft polymer, stereoblock polymer.



blood. A complex, liquid tissue of d 1.056 and pH 7.35–7.45. It is comprised of erythrocytes (red cells), leucocytes (white cells), platelets, plasma, proteins, and serum. The plasma fraction (55–70%) is whole blood from which the red and white cells and the platelets have been removed by centrifuging. Hemoglobin is a protein found in the erythrocytes. It contains the essential iron atom and functions as the transport agent for oxygen to the heart (artery) and of carbon dioxide from the heart (vein). Experimental work has been reported on the effectiveness of fluorocarbon compounds in carrying out the essential transport functions of blood, especially of the red cells.
Use: Plasma is used to restore liquid volume and thus osmotic pressure in the body where blood loss has been extensive. Animal blood is used as a component of adhesive mixtures. In dried or powder form it is a component of fertilizers poultry feeds and deer repellents.
See also hemoglobin, plasma, platelet, rhesus factor.

bloom. (1) A thin coating of an ingredient of a rubber or plastic mixture that migrates to the surface usually within a few hours after curing or setting. Sulfur bloom in vulcanized rubber products is most common; it is harmless but impairs the eye appeal of the product. Paraffin wax is often included purposely; when it migrates to the surface it provides an efficient barrier to sunchecking and oxidation.
(2) A piece of steel made from an ingot.
(3) An arbitrary scale for rating the strength of gelatin gels. When so used the word is capitalized.
(4) Efflorescence of phytoplankton in sea water causing discoloration of the surface water.
See red tide.

blowing agent. A substance incorporated in a mixture for the purpose of producing a foam. One type decomposes when heated to processing temperature to evolve a gas, usually carbon dioxide, which is suspended in small globules in the mixture. Typical blowing agents of this kind are baking powder (bread and cake), sodium bicarbonate or ammonium carbonate (cellular or sponge rubber), halocarbons and methylene chloride in urethane, pentane in expanded polystyrene, hydrazine and related compounds in various types of foamed plastics. Another type is air used at room temperature as a blowing agent for rubber latex; it is introduced mechanically by whipping, after which the latex is coagulated with acid. Air is also used for this purpose in ice cream, whipped cream, and other food products, as well as in blown asphalt and blown vegetable oils.
See also foam.

blow molding. A technique for production of hollow thermoplastic products. It involves placing an extruded tube (parison) of the thermoplastic in a mold and applying sufficient air pressure to the inside of the tube to cause it to take on the conformation of the mold. Polyethylene is usually used but a number of other materials are adaptable to this method, e.g., cellulosics, nylons, polypropylene, and polycarbonates. It is an economically efficient process and is especially suitable for production of toys, bottles, and other containers as well as air-conditioning ducts and various industrial items. The method is not limited to hollow products; e.g., housings can be made by blowing a unit and sawing it along the parting line to make two housings.

blown asphalt. See asphalt, blown.

blown oil. (oxidized oil; base oil; thickened oil; polymerized oil). Vegetable and animal oils which have been heated and agitated by a current of air or oxygen. They are partially oxidized, deodorized, and polymerized by the treatment and are increased in density, viscosity and drying power. Common blown oils are castor, linseed, rape, whale and fish oils.
Use: Paints, varnishes, lubricants, and plasticizers.

blue copperas. See copper sulfate.

blue cross gas. See diphenylchloroarsine.

blue gas. See water gas.

blue lead. See lead sulfate, blue basic.

blueprint. See Turnbull's Blue.

blue verdigris. See copper acetate, basic.

blue vitriol. See cop

blush. Precipitation
of colloidal droplet
or lacquer film cau
perature immediat
due to solvent eva
sightly graying of
avoided by use of

board. See paperboa

BOD. See biochemi

body. (1) A non-spe
onymous with con
descriptive of liqui
seed oil which has
See also consistency
(2) In biochemistry
present in the blo
See agglutination.
(3) An object havin
e.g., blackbody.

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ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY

FOURTH EDITION

VOLUME 7

COMPOSITE MATERIALS
TO
DETERGENCY

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equipment for oil and gas production and chemical processing. U.S. consumption in 1988 was 3100 t (76).

Alternating Copolymers

Poly(styrene-*alt*-maleic anhydride) [*9011-13-6*] is a classic and commercial example of an alternating copolymer (77). This material is manufactured by free-radical bulk, solution, or emulsion copolymerization. Important producers are ARCO (SMA) and Monsanto (Lytron). Such copolymer resins are brittle and insoluble in most solvents. But they are soluble in alkaline solution and react with water to give acids, with alcohols to give esters, and with amines to give amides. They can be converted to insoluble, infusible thermosets by heating with diamines or glycols. These resins and their derivatives are seldom used alone but are used as dispersants (to increase the pigment concentration) and floor polishes (to act as emulsifiers and protective colloids). Maleic anhydride can also form alternating copolymers with various olefins (EMA Resin, Monsanto) and vinyl ethers (Gantrez An-Resin, General Aniline and Film Corp.).

Maruzen Oil Co. has developed various Ziegler-Natta catalysts that can produce poly(butadiene-*alt*-propylene) (PBR) (78). PBR shows tack (self-adhesion) and green (unvulcanized) dynamic properties superior to those of BR and EPDM. Carbon black-loaded vulcanizates can be compounded to give high strength and elongation at break (79,80). PBR can also be covulcanized with SBR, BR, and EPDM.

Block Copolymers

Block copolymers have become commercially valuable commodities because of their unique structure–property relationships. They are best described in terms of their applications such as thermoplastic elastomers (TPE), elastomeric fibers, toughened thermoplastic resins, compatibilizers, surfactants, and adhesives (see ELASTOMERS, SYNTHETIC—THERMOPLASTIC).

A thermoplastic elastomer is a material that combines the processability of a thermoplastic with the performance of a thermoset rubber. A thermoplastic elastomer (81) results when block copolymers have an ABA, $(AB)_nX$, or $-(AB)-_n$ but not an AB diblock arrangement of A (thermoplastic) and B (rubbery) blocks. The hard A blocks may be glassy (eg, polystyrene) or crystalline (eg, polyester, polyurethane); the soft B blocks must be elastomeric (eg, polybutadiene, polyisoprene, polyether). When the hard segments are incompatible with the soft segments, the domains or regions of hard blocks act as reinforcing physical cross-links for the rubbery matrix. In contrast to chemically cross-linked rubbers, the physical network is thermally reversible. When the polymer is heated above the T_g (or T_m) of the hard block, the hard blocks soften and allow the rubber to flow and to be processed as a thermoplastic. Table 4 shows some commercially important TPE block copolymers and their producers.

The manufacture of block copolymer TPE depends on the type and arrangement of the blocks. For example, butadiene–styrene ABA, $(AB)_nX$ block copoly-

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Table 4. Comm

Comonomer
styrene–diene (I
styrene–diene
urethane–ester
ester–ether

[a]Ref. 82.

Table 5. Prope

Property
tensile
recovery
upper use temp
lower use temp
aging stability
acid–base resis
oil resistance
electrical
abrasion resist
melt processab
cost

[a]Ref. 83.
[b]A designation

mers are conveniently prepared by alkyllithium initiated anionic polymerization. Thermoplastic $-(AB)-_n$ polyurethanes are synthesized by step-growth addition copolymerization of dihydroxy compounds such as polytetramethylene ether glycol and toluene diisocyanate. The copolyester–ether $(AB)-_n$ copolymers are produced by the polycondensation of dicarboxylic acids (eg, terephthalic acid) with glycols or polyether glycols.

The physical properties of block copolymer TPE also depend on the type and arrangement of the blocks. Table 5 compares the property advantages of various block copolymer thermoplastic elastomers.

The properties and prices of the various block copolymer TPE greatly affect their markets. For example, the low cost butadiene–styrene block copolymers have found utility in footwear (sneakers, tennis shoes), injection-molded or extruded goods (automotive sight shields, fender extensions, toys, housewares), and adhesives (solvent cement and hot-melt types). The principal commercial supplier of styrenic block copolymers is Shell (Kraton). In addition, two joint ventures have been announced to produce these materials. Dow Chemical and Exxon have

Table 4. Commercially Important Block Copolymer TPE[a]

Comonomer	Block arrangement	Trade name	Producer
styrene–diene (hydrogenated styrene–diene)	ABA, $(AB)_nX$	Kraton	Shell
urethane–ester (ether)	$-(AB)-_n$	Vector Estane Texin	Dexco B. F. Goodrich Mobay
ester–ether	$-(AB)-_n$	Hytrel	Du Pont

[a]Ref. 82.

Table 5. Property Advantages of Various Block Copolymer TPE[a,b]

Property	Styrene–diene	Hydrogenated styrene–diene	Ester–ether	Urethane–ester
tensile			+	+
recovery	+	+		
upper use temperature			+	+
lower use temperature	+	+		
aging stability		+		
acid–base resistance	+	+		
oil resistance			+	+
electrical	+	+		
abrasion resistance				+
melt processability			+	+
cost	+			

[a]Ref. 83.
[b]A designation of + indicates a performance strong point.

formed Dexco Polymers to produce systemic block copolymers for pressure-sensitive adhesive, asphalt (qv), and thermoplastic impact modifier markets. The second joint venture is EnArco, formed by ARCO Chemical Co. and Enimont. This venture will produce products for similar applications (84). The U.S. consumption of these materials as of 1989 was 139,000 t (85). These materials typically possess a high volume fraction of styrene and are priced between the low cost resins, polystyrene, polyethylene, etc and the high cost resins, cellulosic, clear ABS, polycarbonates, etc. These same materials are used as compatibilizers and impact modifiers in polymer blends. Here, they lower surface tension, decreasing domain size in two-phase blends, usually resulting in improved properties, such as impact strength and flexural modulus.

Polyurethane TPE exhibit toughness, low temperature flexibility, strength, and abrasion resistance. They are produced using a bulk or solution reaction of a polyol with a diisocyanate and are used largely in fabric coatings and injection molded and extruded goods (exterior automotive parts, gears, gaskets, etc). Important commercial producers include BASF (Elastollan), Bayer (Desmopan), Dow Chemical (Pellethane), and B. F. Goodrich (Estane). U.S. production is estimated at 21,000 t (86).

In contrast, the copolyester–ether block copolymer TPE are relatively expensive with high performance characteristics. These materials exhibit a two-phase morphology in which the hard crystalline segments made from polyester act as thermally reversible cross-links. The elastomeric character of the polymer arises from the amorphous soft polyether ester segments. They are produced by a melt-transesterification polymerization process and can be processed by conventional techniques such as injection, blow, transfer, or rotational molding. Important commercial products are produced by Du Pont (Hytrel), Eastman Kodak (Ecdel), General Electric (Lomod), and Hoechst Celanese (Riteflex). U.S. copolyester–ether consumption in 1988 was 12,000 t. Their most important uses are in wire cable materials (eg, the coiled stretch telephone cords), injection-molded articles (eg, small mechanical parts), and high pressure hoses (87).

Certain block copolymers have also found application as surfactants (88). For example, AB or ABA block copolymers in which one block is hydrophilic and one block is hydrophobic have proven useful for emulsifying aqueous and non-aqueous substances and for wetting the surface of materials. Examples of such surfactants are the poly(propylene oxide-*block*-ethylene oxide) materials, known as Pluronics (BASC Wyandotte Co.).

Graft Copolymers

Two commercially significant graft copolymers are acrylonitrile–butadiene–styrene (ABS) resins and impact polystyrene (IPS) plastics. Both of these families of materials were once simple mechanical polymer blends, but today such compositions are generally graft copolymers or blends of graft copolymers and homopolymers.

ABS is the sixth largest volume thermoplastic resin and the principal engineering (structural or load bearing) plastic (89). ABS is a terpolymer manufactured by copolymerizing acrylonitrile and styrene in the presence of polybutadiene